

WHAT IS CLAIMED IS:

1. A method for forming at least one opening in an organic-containing insulating layer, comprising:

covering the organic-containing insulating layer with a bilayer comprising a resist hard mask layer and a resist layer, wherein the resist hard mask layer is formed on the organic-containing insulating layer, and wherein the resist layer is formed on the resist hard mask layer;

patterning the bilayer, whereby a patterned bilayer is obtained; and

plasma etching the organic-containing insulating layer in a reaction chamber containing a gaseous mixture, whereby an opening is created in the organic-containing insulating layer, wherein the gaseous mixture comprises a fluorine-containing gas and an inert gas, wherein the gaseous mixture contains essentially no oxygen-containing gas, wherein substantially no etch residue is deposited while creating the opening, and wherein the side walls of the opening are fluorinated such that anisotropy of the plasma etching is increased.

2. The method according to claim 1, wherein the organic-containing insulating layer comprises at least one unsaturated carbon bond.

3. The method according to claim 2, wherein the organic-containing insulating layer comprises a material selected from the group consisting of benzocyclobutarenes, poly arylene ethers, aromatic hydrocarbons, and polyamides.

4. The method according to claim 1, wherein the resist hard mask layer comprises a material selected from the group consisting of silicon oxide, silicon nitride, silicon oxynitride, silicon carbide, and silicon oxycarbide.

5. The method according to claim 1, wherein the inert gas comprises nitrogen.

6. The method according to claim 5, wherein a ratio of an amount of nitrogen in the gaseous mixture to an amount of fluorine containing gas in the gaseous mixture is greater than 2:1.

7. The method according to claim 1, wherein the fluorine-containing gas is selected from the group consisting of SF₆, NF₃, C₂F₆, CF₄, CHF₃, CH₃F, CH₂F₂, and mixtures thereof.

8. The method according to claim 1, wherein the opening comprises at least one via hole, the via hole extending through the organic-containing insulating layer to an underlying conductive layer or an underlying barrier layer.